



THE AQUATIC PLANT COMMUNITY OF PARKER LAKE, ADAMS COUNTY, WISCONSIN

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ADAMS COUNTY 2005-2006

I. INTRODUCTION

An aquatic macrophytes (plants) field study in Parker Lake was conducted during August 2005 by a staff member of the Adams County Land and Water Conservation Department. Results were shared with the Wisconsin Department of Natural Resources.

Information about the diversity, density and distribution of aquatic plants is an essential component in understanding the lake ecosystem due to the integral ecological role of aquatic vegetation in the lake and the ability of vegetation to impact water quality (Dennison et al, 1993). This study will provide information useful for effective management of Parker Lake, including fish habitat improvement, protection of sensitive areas, aquatic plant management, and water resource regulation. This baseline data will provide information that can be used for comparison to future information and offer insight into changes in the lake.

Ecological Role: Lake plant life is the beginning of the lake's food chain, the foundation for all other lake life. Aquatic plants and algae provide food and oxygen for fish and wildlife, as well as cover and food for the invertebrates that many aquatic organisms depend on. Plants provide habitat and protective cover for aquatic animals. They also improve water quality, protect shorelines and lake bottoms, add to the aesthetic quality of the lake, and impact recreation.

Characterization of Water Quality: Aquatic plants can serve as indicators of water quality because of their sensitivity to water quality parameters such as clarity and nutrient levels (Dennison et al, 1993).

Background and History: Parker Lake is located in the Town of Jackson, Adams County, Wisconsin. The seepage lake is 60 surface acres in size. Maximum depth is 30'+, with an average depth of 13'. About 21% of the lake is over 20' deep. The shoreline is 1.16 miles, with some disturbance at most of it. There is a public wayside (1300' of shore) located on the north side of the lake with a concrete path leading to the water. Although there is no public boat launch, the Parker Lake Lodge permits boats to be launched for a fee of \$3.

Parker Lake is easily accessible off of State Highway 82. Residential development in both the surface and groundwatersheds is concentrated along the lakeshore. The surface watershed is about ½ agriculture and ½ woodland use. There are both terrestrial and aquatic Natural Heritage Communities directly south of the lake. Waterfowl, especially ducks, use this lake during spring and fall.

Fish inventories dating back to 1968 show that largemouth bass and panfish are abundant to common, depending on the species. Stocking from 1967 to 1992 included brown, rainbow & brook trout, bluegills, and walleyes. No rainbow trout or walleye were stocked after 1981, when it was determined that they weren't maintaining a population in the lake. Northern pike are found, but scarce. There was a carp eradication by chemicals in 1965.

A DNR Report from the 1960s found Parker Lake to be a "clear, hard water seepage lake with moderate transparency." The Parker Lake Association

commissioned a private assessment in 1998 that reported the lake to be “relatively clear...with nutrient levels typically indicating mesotrophic conditions.”

Both Eurasian Watermilfoil and Curly-Leaf Pondweed were reported in the lake prior to 2003.

II. METHODS

Field Methods

The study was based on the rake-sampling method developed by Jessen and Lound (1962), using stratified random transects. The shoreline was divided into 12 equal sections, with a transect placed randomly within each segment, perpendicular to the shoreline.

One sampling site was randomly chosen in each depth zone (0-1.5'; 1.5'-5'; 5'-10'; 10'-20') along each transect. Using long-handled, steel thatching rakes, four rake samples were taken at each site. Samples were taken from each quarter around the boat. Aquatic species present on each rake were recorded and given a density rating of 0-5.

A rating of 1 indicates the species was present on 1 rake sample.

A rating of 2 indicates the species was present on 2 rake samples.

A rating of 3 indicates the species was present on 3 rake samples.

A rating of 4 indicates the species was present on 4 rake samples.

A rating of 5 indicates that the species was abundantly present on all rake samples.

A visual inspection and periodic samples were taken between transects to record the presence of any species that didn't occur at the raking sites. Gleason and Cronquist (1991) nomenclature was used in recording plants found.

Shoreline type was also recorded at each transect. Visual inspection was made of 50' to the right and left of the boat along the shoreline, 35' back from the shore (so total view was 100' x 35'). Percent of land use within this rectangle was visually estimated and recorded.

Data Analysis:

The percent frequency (number of sampling sites at which it occurred/total number of sampling sites) of each species was calculated. (See Appendix A) Relative frequency (number of species occurrences/total all species occurrences) was also determined. (See Appendix A) The mean density (sum of species' density rating/number of sampling sites) was calculated for each species. (See Appendix B) Relative density (sum of species' density/total plant density) was also determined. (See Appendix B) Mean density where present (sum of species' density rating/number of sampling sites at which species occurred) was calculated. (See Appendix B) Relative frequency and relative density results were summed to obtain a dominance value. (See Appendix C) Species diversity was measured by Simpson's Diversity Index. (See Appendix A)

The Average Coefficient of Conservation and Floristic Quality Index were calculated as outlined by Nichols (1998) to measure plant community disturbance. A coefficient of conservation is an assigned value between 0 and 10 that measures the probability that the species will occur in an undisturbed habitat. The Average Coefficient of Conservationism is the mean of the coefficients for the species

found in the lake. The coefficient of conservatism is used to calculate the Floristic Quality Index, a measure of a plant community's closeness to an undisturbed condition.

An Aquatic Macrophyte Index was determined using the method developed by Nichols et al (2000). This measurement looks at the following seven parameters and assigns each of them a number on a scale of 1-10: maximum depth of plant growth; percentage of littoral zone vegetated; Simpson's diversity index; relative frequency of submersed species; relative frequency of sensitive species; taxa number; and relative frequency of exotic species. The average total for the North Central Hardwoods lakes and impoundments is between 48 and 57.

III. RESULTS

Physical Data

The aquatic plant community can be impacted by several physical parameters. Water quality, including nutrients, algae and clarity, influence the plant community; the plant community in turn can modify these boundaries. Lake morphology, sediment composition and shoreline use also affect the plant community.

The trophic state of a lake is a classification of water quality (see Table 1). Phosphorus concentration, chlorophyll a concentration and water clarity data are collected and combined to determine a trophic state. **Eutrophic lakes** are very productive, with high nutrient levels and large biomass presence. **Oligotrophic lakes** are those low in nutrients with limited plant growth and small fisheries. **Mesotrophic lakes** are those in between, i.e., those which have increased production over oligotrophic lakes, but less than eutrophic lakes; those with more

biomass than oligotrophic lakes, but less than eutrophic lakes; those with a good and more varied fishery than either the eutrophic or oligotrophic lakes.

The limiting factor in most Wisconsin lakes, including Parker Lake, is phosphorus. Measuring the phosphorus in a lake system thus provides an indication of the nutrient level in a lake. Increased phosphorus in a lake will feed algal blooms and also may cause excess plant growth. **The 2004-2006 summer average phosphorus concentration in Parker Lake was 14.08 ug/ml.** This concentration suggests that Parker Lake is likely to have some nuisance algal blooms, but not frequent ones. This places Parker Lake in the “very good” water quality section for natural lakes and in the mesotrophic level for phosphorus.

Chlorophyll concentrations provide a measurement of the amount of algae in a lake’s water. Algae are natural and essential in lakes, but high algal populations can increase water turbidity and reduce light available for plant growth. **The 2004-2006 summer average chlorophyll concentration in Parker Lake was 2.84 ug/ml.** This is very low, placing Parker Lake at the oligotrophic level for chlorophyll a results.

Water clarity is a critical factor for plants. If plants don’t get more than 2% of the surface illumination, they won’t survive. Water clarity can be reduced by turbidity (suspended materials such as algae and silt) and dissolved organic chemicals that color or cloud the water. Water clarity is measured with a Secchi disk. **Average summer Secchi disk clarity in Parker Lake in 2004-2006 was 10.73’.** This is good to very good water clarity, putting Parker Lake into the oligotrophic category for water clarity.

It is normal for all of these values to fluctuate during a growing season. They can be affected by human use of the lake, by summer temperature variations, by algae growth & turbidity, and by rain or wind events. Phosphorus tends to rise in early summer, then decline as late summer and fall progress. Chlorophyll a tends to rise in level as the water warms, then decline as autumn cools the water. Water clarity also tends to decrease as summer progresses, probably due to algae growth, then decline as fall approaches.

Table 1: Trophic States

Trophic State	Quality Index	Phosphorus (ug/ml)	Chlorophyll a (ug/ml)	Secchi Disk (ft)
Oligotrophic	Excellent	<1	<1	>19
	Very Good	1 to 10	1 to 5	8 to 19
Mesotrophic	Good	10 to 30	5 to 10	6 to 8
	Fair	30 to 50	10 to 15	5 to 6
Eutrophic	Poor	50 to 150	15 to 30	3 to 4
Parker Lake		14.08	2.84	10.73

According to these results, Parker Lake scores as “**mesotrophic**” in its phosphorus levels and “**oligotrophic**” in water clarity and chlorophyll a readings. This state would favor moderate plant growth, occasional algal blooms and very good water clarity.

Lake morphology is an important factor in distribution of lake plants. Duarte & Kalff (1986) determined that the slope of a littoral zone could explain 72% of the observed variability in the growth of submerged plants. Gentle slopes support higher plant growth than steep slopes (Engel 1985).

Parker Lake is a fairly round basin that gradually slopes into a small deep section just past the center towards the east side of the lake. There are small areas of steeper slopes within the lake where the drop off is quicker on the south shore. With the high water clarity, plant growth may be favored in more of Parker Lake than one might expect since the sun can get to a fair amount of the sediment to stimulate plant growth.

Sediment composition can also affect plant growth, especially those rooted. The richness or sterility and texture of the sediment will determine the type and abundance of macrophyte species that can survive in a particular lake (see Table 2 and Appendix A).

Table 2: Sediment Composition—Parker Lake
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Sediment	Type	0-1.5'	1.5'-5'	5'-10'	10'-20'	All Sites
Hard	Sand	8.33%	8.33%	16.67%	50.00%	39.58%
Mixed	Sand/Marl		8.33%	25.00%		8.33%
	Sand/Silt		16.67%	16.67%	8.33%	10.42%
Soft	Marl		33.33%	16.67%	41.67%	22.92%
	Marl/Muck		16.67%			4.17%
	Marl/Peat		16.67%	16.67%		8.33%
	Muck	16.67%				4.17%
	Silt		8.33%			2.08%

The sediment in Parker Lake is quite varied. Although sand sediment may limit growth, all sandy sites in Parker Lake were vegetated. In fact, all sample sites were vegetated in Parker Lake, no matter what the sediment (see Appendix G).

Shoreline land use often strongly impacts the aquatic plant community and thus the entire aquatic community. Impacts can be caused by increased erosion and sedimentation and higher run-off of nutrients, fertilizers and toxins applied to the land. Such impacts occur in both rural and residential settings.

Native herbaceous vegetation was the shoreline cover of the highest mean coverage (see Table 3). But disturbed sites, such as those with traditional lawn, rock/riprap, hard structures and pavement, were also common, covering nearly half the shoreline (46.25%). Bare unprotected sand was found at many sites as well (12.5%).

Table 3: Shoreland Land Use—Parker Lake

Cover Type		Occurrence frequency at transects	Percent Coverage
Vegetated	Wooded	50.00%	14.58%
Shoreline	Herbaceous	100.00%	23.33%
	Shrubs	41.67%	3.75%
Disturbed	Cultivated Lawn	66.67%	22.92%
Shoreline	Hard Structures	58.33%	5.83%
	Rock/riprap/pavement	33.33%	17.5%
	Bare Sand	66.67%	12.5%

Some type of vegetated shoreline was found at 100% of the sites, but only covered 41.66% of the shoreline.

Macrophyte Data

SPECIES PRESENT

Of the 21 species found in Parker Lake, 18 were native and 3 were exotic imports. In the native plant category, eight were emergent, one was a floating-leaf rooted plant, and eight were submergent types (see Table 4). One macrophytic (plant-like) algae,

Chara spp. (muskgrass) was found at nearly all the sample sites. No endangered or threatened species were found. Three exotic invasives, *Myriophyllum spicatum* (Eurasian Water Milfoil), *Phalaris arundinacea* (reed canary grass), and *Potamogeton crispus* (Curly-Leaf Pondweed) were found.

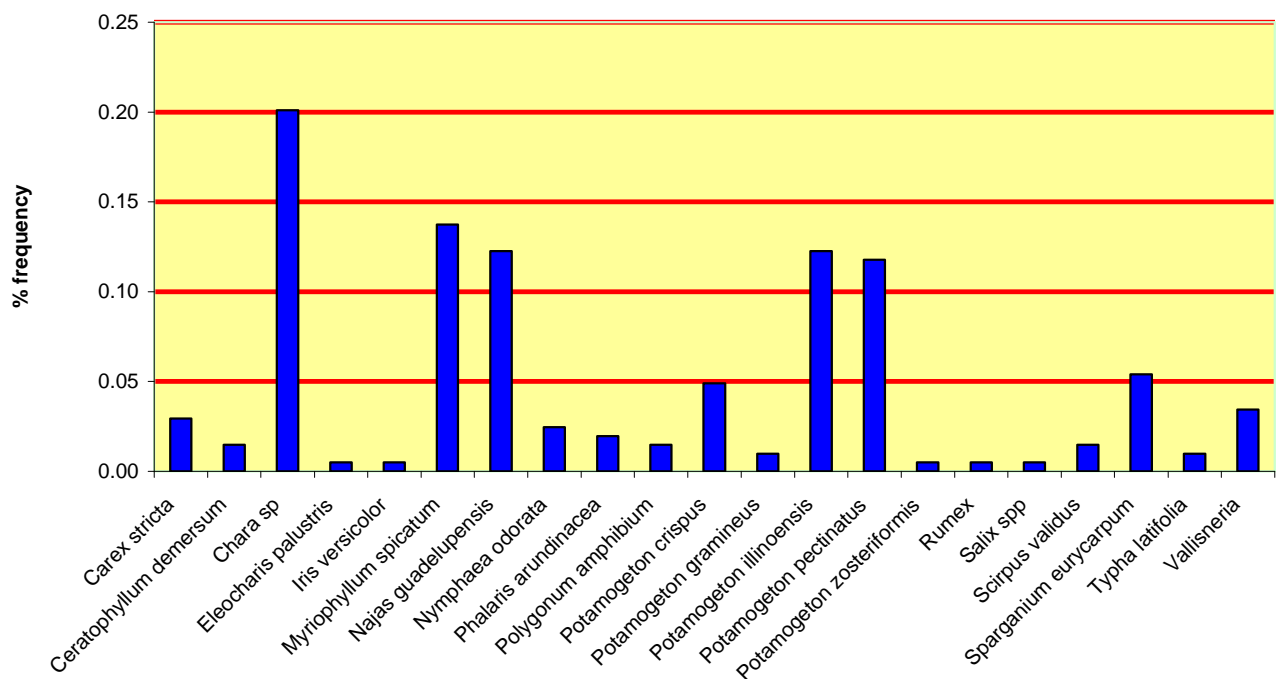
Table 4—Plant Found in Parker Lake, 2005

<u>Emergent Plants</u>	
<i>Carex stricta</i>	Tussock Sedge
<i>Eleocharis palustris</i>	Creeping Spikerush
<i>Iris versicolor</i>	Blue-Flag Iris
<i>Phalaris arundinacea</i>	Reed Canarygrass
<i>Rumex</i> spp	Water Dock
<i>Salix</i> spp	Willow
<i>Scirpus validus</i>	Soft-Stem Bulrush
<i>Sparganium eurycarpum</i>	Common Burreed
<i>Typha latifolia</i>	Narrow-Lead Cattail
<u>Floating-Leaf Rooted Plants</u>	
<i>Nymphaea odorata</i>	White Water Lily
<i>Polygonum amphibium</i>	Water Smartweed
<u>Submergent Plants</u>	
<i>Ceratophyllum demersum</i>	Coontail
<i>Myriophyllum spicatum</i>	Eurasian Watermilfoil
<i>Najas guadelupensis</i>	Southern Naiad
<i>Potamogeton crispus</i>	Curly-Leaf Pondweed
<i>Potamogeton gramineus</i>	Variable-Leaf Pondweed
<i>Potamogeton illinoensis</i>	Illinois Pondweed
<i>Potamogeton pectinatus</i>	Sage Pondweed
<i>Potamogeton zosteriformis</i>	Flat-Stem Pondweed
<i>Vallisneria americana</i>	Water Celery
<u>Plant-Like Algae</u>	
<i>Chara</i> spp	Muskgrass

FREQUENCY OF OCCURRENCE

Chara spp. was the most frequently-occurring “plant” in Parker Lake in 2005 (85.42% frequency). Three other species reached a frequency of 50% or greater: *Myriophyllum spicatum* (Eurasian watermilfoil), *Potamogeton illinoensis* (Illinois pondweed), and *Potamogeton pectinatus* (Sago pondweed) (at 58.33%, 52.08% and 50% respectively) (See Chart 1).

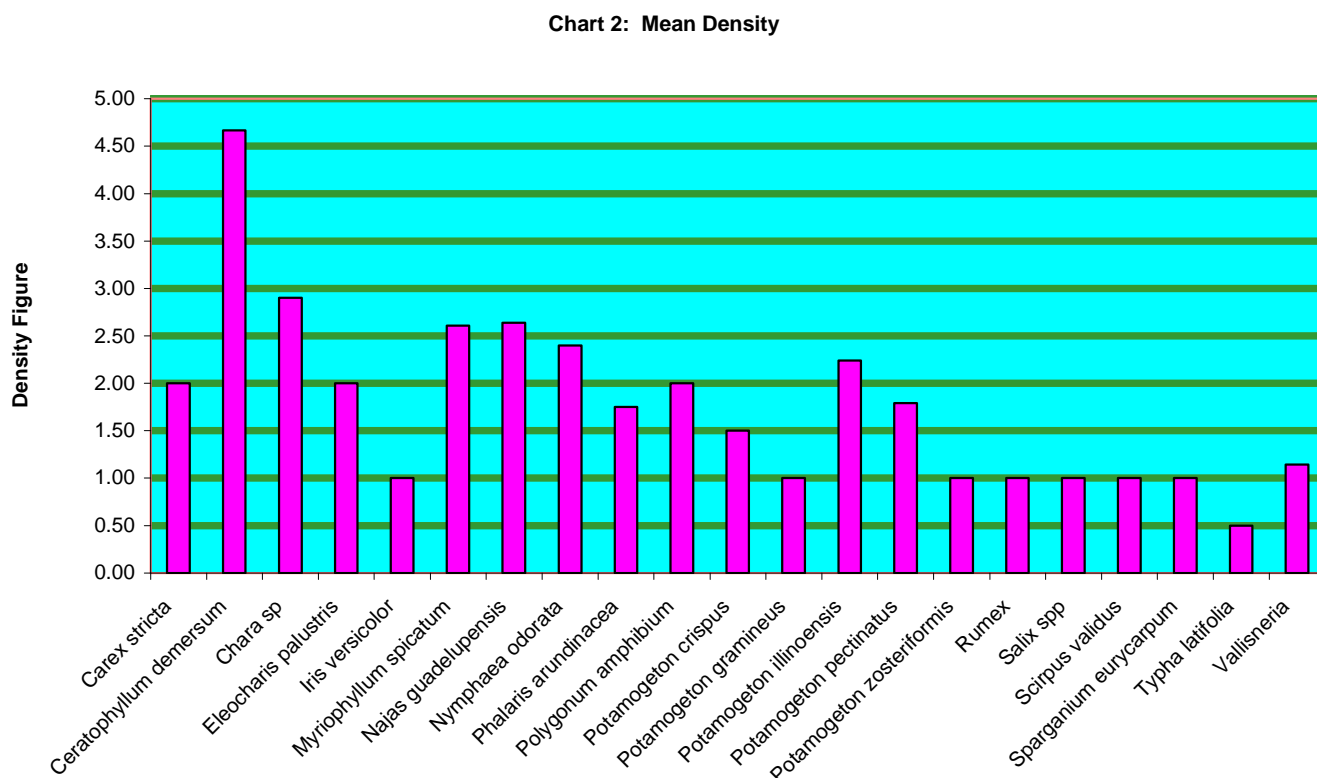
Chart 1: Species Frequency



Filamentous algae was found at 29.17% of the sample sites. It occurred at 67% of the 0-1.5' depth; at 33% of the 1.5'-5' depth sites; and at 17% of the 5'-10' sites. None was found at sites over 10' in depth.

DENSITY OF OCCURRENCE

Ceratophyllum demersum (coontail) was the species with the highest mean density (4.67 on a scale of 1-5) in Parker Lake. (See Chart 2)

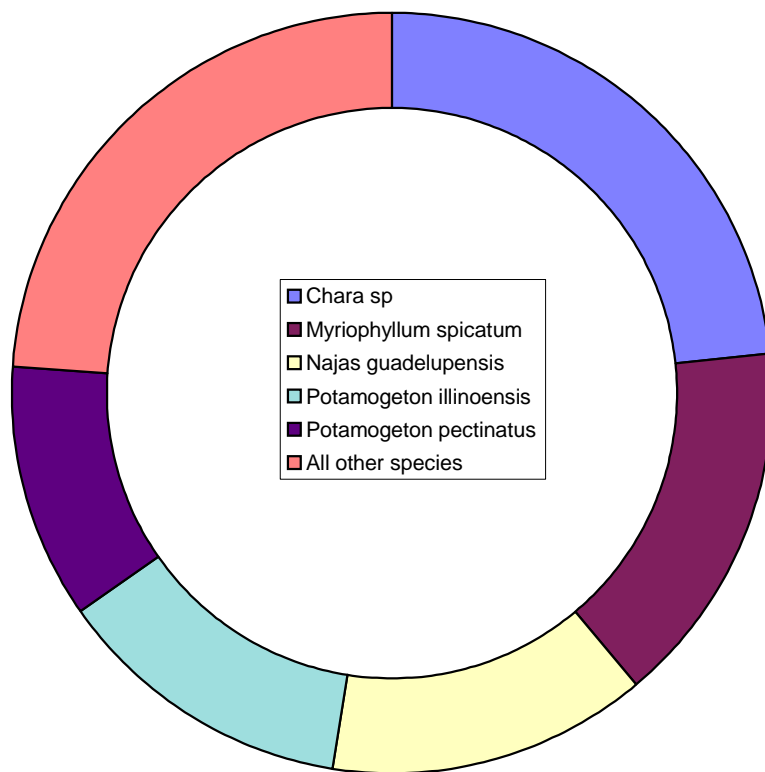


A mean density over 2.0 suggests that a species is present at higher than average density. In Parker Lake, in addition to *Ceratophyllum demersum* mentioned above, the following aquatic species were found in higher than usual average densities: *Chara* spp.; *Myriophyllum spicatum*; *Najas guadelupensis* (Southern naiad); *Nymphaea odorata* (white water lily); and *Potamogeton illinoensis*.

DOMINANCE

Relative frequency and relative density are combined into a dominance value that demonstrates how dominant a species is within its aquatic plant community. Based on dominance value, *Chara* spp was the dominant aquatic plant species in Parker Lake (see Chart 3). Sub-dominant were *Myriophyllum spicatum*, *Najas guadelupensis*, and *Potamogeton illinoensis*. *Potamogeton crispus* and *Phalaris arundinacea*, the other two exotics found in Parker Lake, were not present in high frequency, high density or high dominance.

Chart 3: Dominance



Chara spp. was dominant in all depth zones. *Myriophyllum spicatum* was dominant only in Zone 1 (0-1.5' depth). *Potamogeton illinoensis* was sub-dominant in Zone 2 (1.5'-5') and Zone 3 (5'-10'), but not in Zones 1 or 4. *Najas guadelupensis* was subdominant only in Zone 2.

DISTRIBUTION

Aquatic plants occurred at 100% of the sample sites in Parker Lake to a maximum rooting depth of 18.5'. (see Figure 4 and Appendix H). Rooted-floating-leaf plants were found in only in the two shallowest zones (see Appendix B).

Chart 4: Macrophyte Frequency

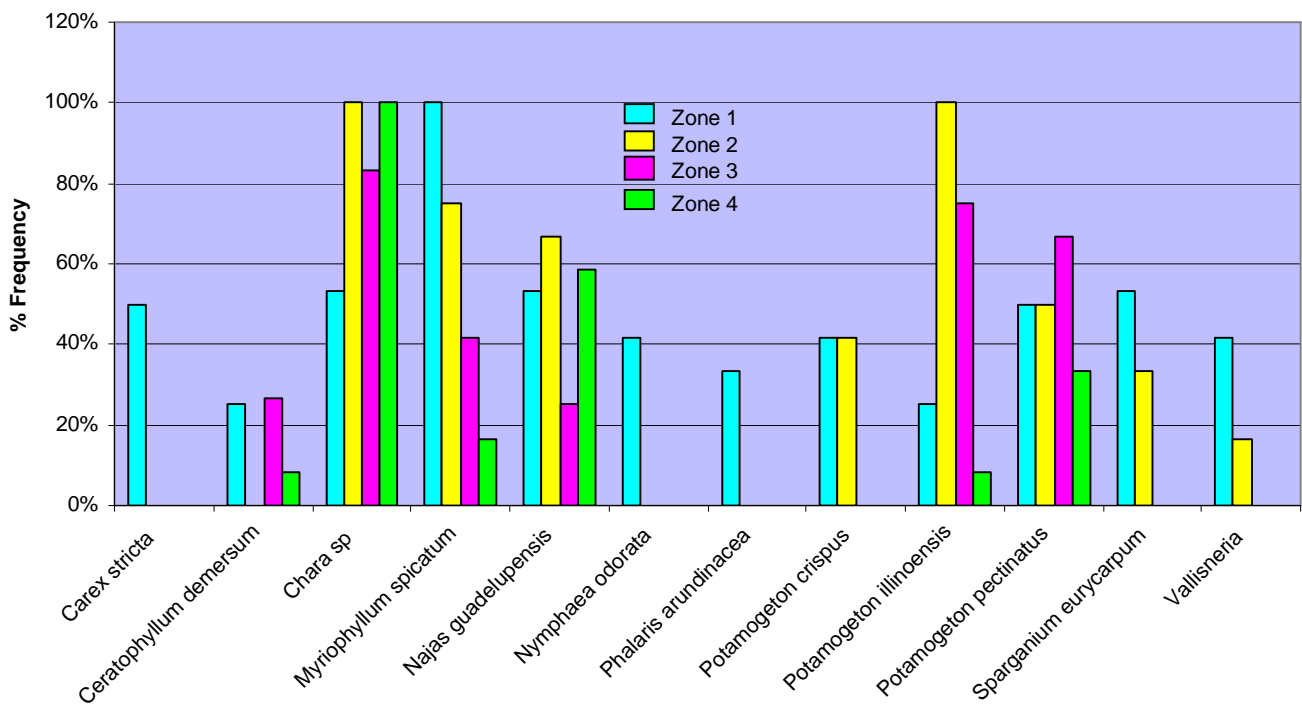
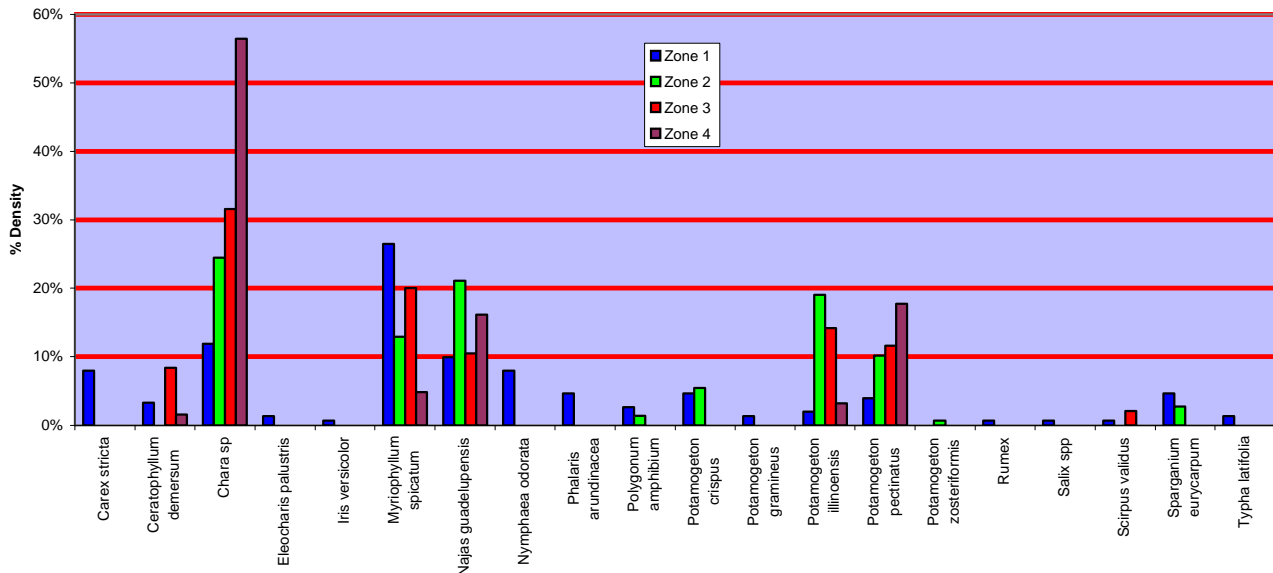


Chart 5: Macrophyte Density



Secchi disc readings are used to predict maximum rooting depth for plants in a lake (Dunst, 1982). Based on the summer 2004-2005 Secchi disc readings, the predicted maximum rooting depth in Parker Lake would be **15.82 feet**. During the 2005 aquatic plant survey, rooted plants were found at a depth of 18.5', i.e., rooted plants were found deeper than would usually be expected by Dunst calculations.

The 0-1.5' depth zone (Zone 1) produced the most frequently occurring and densest plant growth. However, Zone 2 (1.5'-5') also had high frequency and high density of aquatic plants. Both frequency and density then dropped off sharply at depths over 10', although plants were still found in those depths.

Chart 6: Total Frequency

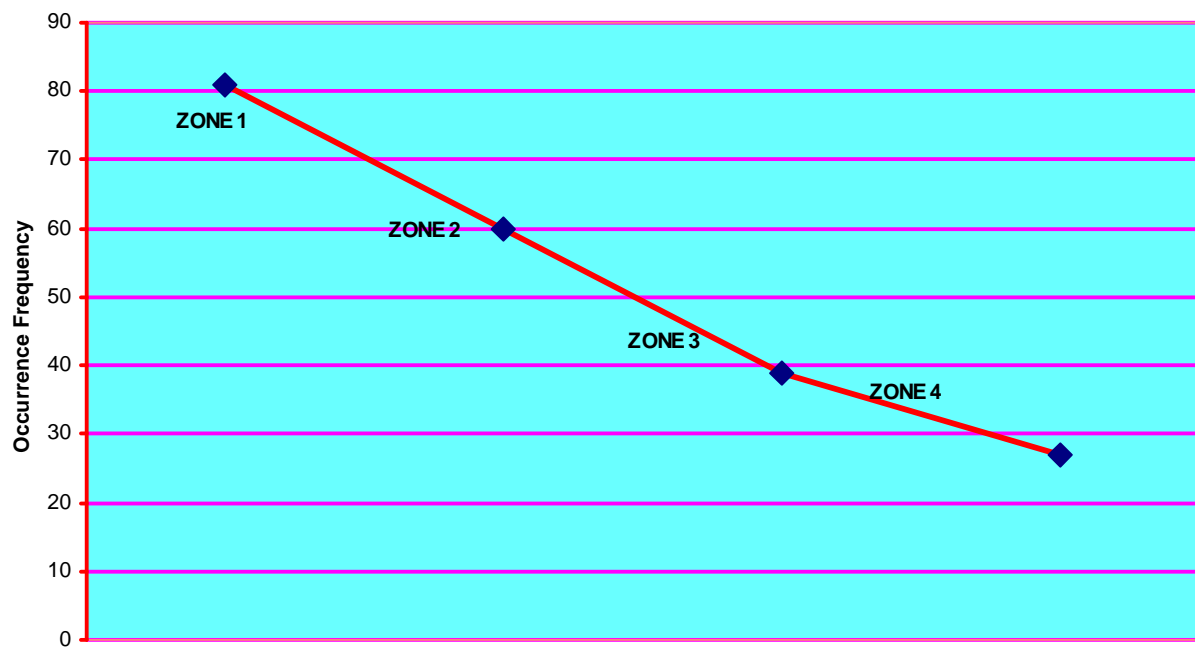
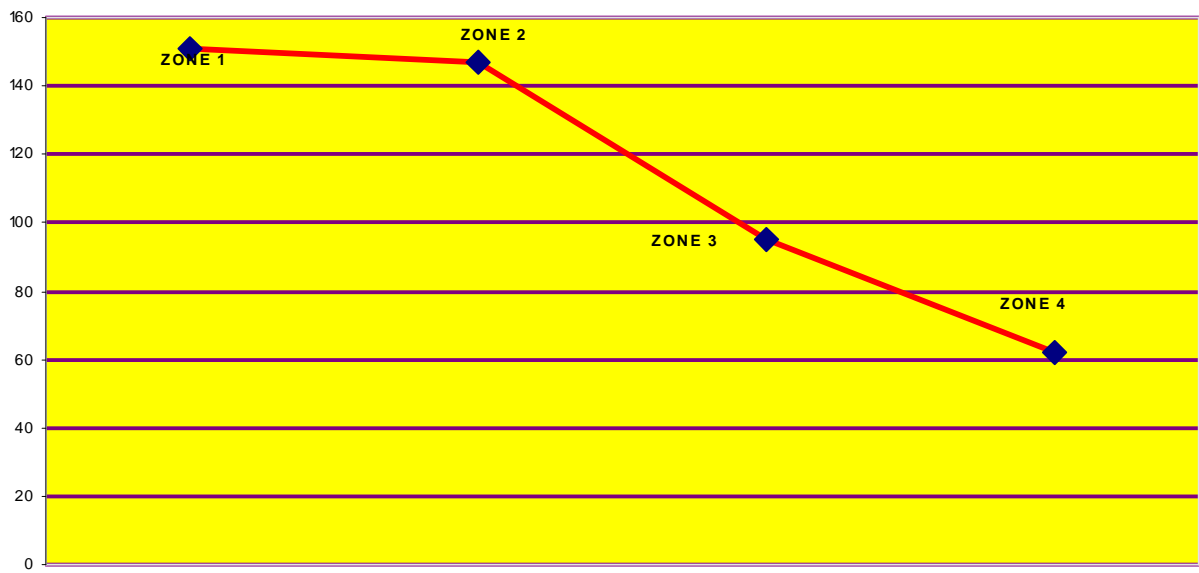


Chart 7: Total Density



The greatest number of species per site (species richness) was found in Zone 3, with a 3.44 richness score. Zone 1 had the lowest species richness (1.96), followed by Zone 4 (2.29 richness) and Zone 2 (2.55 richness). Overall species richness was 2.3.

THE COMMUNITY

The Simpson's Diversity Index for Parker Lake was .88, suggesting good species diversity. A rating of 1.0 would mean that each plant in the lake was a different species (the most diversity achievable). The Aquatic Macrophyte Community Index (AMCI) for Parker Lake is 56. This is in the average range for Central Wisconsin Hardwood Lakes and all Wisconsin lakes.

Table 5: Aquatic Macrophyte Community Index

Aquatic Macrophyte Community Index for Arkdale Lake		
<u>Category</u>	<u>Arkdale Lake results</u>	<u>Value</u>
Maximum rooting depth	Over 5 meters	10
% littoral area vegetated	100%	10
%submersed plants	80%	10
% sensitive plants	13%	6
# taxa found	21 (3 exotic)	9
exotic species frequency	21%	3
Simpon's Diversity	0.88	8
total		56

The presence of several invasive, exotic species is a significant factor. A visual survey in late May 2006 indicated Curly-Leaf Pondweed was found in much of the lake, although not in amounts of high frequency or density. Reed Canarygrass was only found in the shallowest depth zone. However, both when the August 2005 survey was done and during the 2006 visual survey, large dense patches of Eurasian Watermilfoil were evident all over the lake (see Appendix I). Its tenacity and ability

to spread to large areas fairly quickly make it a danger to the diversity of Parker Lake's current aquatic plant community.

A Coefficient of Conservatism and a Floristic Index calculation were performed on the field results. Technically, the average Coefficient of Conservatism measures the community's sensitivity to disturbance, while the Floristic Index measures the community's closeness to an undisturbed condition. Indirectly, they measure past and/or current disturbance to the particular community.

Previously, a value was assigned to all plants known in Wisconsin to categorize their probability of occurring in an undisturbed habitat. This value is called the plant's Coefficient of Conservatism. A score of 0 indicates a native or alien opportunistic invasive plant. Plants with a value of 1 to 3 are widespread native plants. Values of 4 to 6 describe native plants found most commonly in early successional ecosystem. Plants scoring 6 to 8 are native plants found in stable climax conditions. Finally, plants with a value of 9 or 10 are native plants found in areas of high quality and are often endangered or threatened. In other words, the lower the numerical value a plant has, the more likely it is to be found in disturbed areas.

The Average Coefficient of Conservation for Parker Lake was 4.05. This puts it in the lowest quartile for Wisconsin Lakes (6.0) and for lakes in the North Central Hardwood Region (5.6). The aquatic plant community in Parker Lake is in the category of those most tolerant of disturbance, probably due to selection by a series of past disturbances.

The Floristic Quality Index of the aquatic plant community in Parker Lake of 18.55 is below average for Wisconsin Lakes (22.2) and the North Central Hardwood Region

(20.9). This indicates that the plant community in Parker Lake is farther from an undisturbed condition than the average lake in Wisconsin overall and in the North Central Hardwood Region. In other words, the aquatic plant community in Parker Lake has been impacted by an above average amount of disturbance.

“Disturbance” is a term that covers many disruptions to a natural community. It includes physical disturbances to plant beds such as boat traffic, plant harvesting, chemical treatments, dock and other structure placements, shoreline development and fluctuating water levels. Indirect disturbances like sedimentation, erosion, increased algal growth, and other water quality impacts will also negatively affect an aquatic plant community. Biological disturbances such as the introduction of non-native and/or invasive species (such as the Eurasian Watermilfoil, Curly-Leaf Pondweed and Reed Canarygrass found here), destruction of plant beds, or changes in aquatic wildlife can also negatively impact an aquatic plant community.

Since only one of the sample transects had an entirely native shore, i.e., 92% of the sites had some kind of human disturbance, calculating Average Coefficient of Conservationism, Floristic Quality Index, Simpson’s Index of Diversity and Aquatic Macrophyte Community Index to compare disturbed to undisturbed shorelines doesn’t seem appropriate in the case of Parker Lake.

Apparent major disturbances to Parker Lake include heavier recreational use, shoreline development, invasion of exotic species, deposition of sediment and fluctuating water levels. In the instance of Parker Lake, it could be that runoff from Highway 82 also causes disturbance in its plant community.

IV. DISCUSSION

Based on water clarity, chlorophyll and phosphorus data, Parker Lake is a mesotrophic seepage lake with good to very good water clarity and good water quality. This trophic state should support moderate plant growth and occasional algal blooms. At times, however, it appears that aquatic plant growth in Parker Lake is higher than the expected “moderate” for this trophic state, most likely due to the invasion of exotics. It is possible that road runoff may also add unwanted nutrients to the lake water that would encourage plant growth.

The filamentous algae present at least 29% of the sites is in keeping with this trophic state.

Sufficient nutrients (trophic state), high water clarity, and increased shore development at Parker Lake favor plant growth. Despite the sometime limiting effect of sand sediments on aquatic plant growth, 100% of the lake is vegetated, suggesting that even the sand sediments in Parker Lake hold sufficient nutrients to maintain aquatic plant growth.

There is no record of mechanical harvesting of aquatic plants in Parker Lake and there have been no recent chemical treatments to try to reduce plant growth, especially that of the exotics. Considering machine harvesting and spot-treating the exotics should help in removing vegetation from the lake and may somewhat help with nutrient reduction. The harvesting should also be designed to set back the growth of Eurasian Watermilfoil, not spread it further.

Aquatic vegetation occurred at 100% of the sample sites, with 94% of the sites having rooted aquatic plants. The maximum rooting depth, based on water clarity

figures, is the less than the found rooted aquatic plant growth. Both the 0-1.5' and 1.5'-5' depth zones had high relative frequency and high density of plants.

The lake does have a good mixture of emergent, floating and rooted plants. Of the 21 species record in Parker Lake in summer 2005, 8 were emergent, 2 were floating-leaf and 8 were rooted. Three very invasive exotics were found during the 2005 field survey: Eurasian watermilfoil; Curly-Leaf pondweed; and Reed canarygrass. In particular, Eurasian watermilfoil is very abundant and dense in much of the lake, making it easy for boat propellers and lake traffic to fragment it and cause further spread. Curly-leaf Pondweed was not found to be abundant in the May 2006 visual survey.

The most developed shore—that along the east side of the lake—has many “grandfathered” buildings that are close to the shore, suggesting that runoff from impervious surfaces such as decks or rooftops could be adding to the pollutant load in the lake. Installation of as much buffer (native) vegetation as possible between the buildings and the ordinary high water mark could filter pollutants and nutrients and help keep them out of the lake water.

Along the southwest shore there is an area of wooded shore that should be preserved as it is to maintain habitat and to serve as a buffer for that area. Studies have suggested that runoff from establish wooded land is substantially less than that of developed areas.

In addition to the area on State Highway 82, 3rd Avenue runs along part of the west side of the lake, close to the lake. This is one area where there was a large mat of Eurasian Watermilfoil. Steps need to be taken to reduce the pollution from road

runoff into the lake at these sites. Near the wayside on Highway 82 is a snag tree that should be left for habitat and anchoring.

The summer 2005 field survey showed that *Myriophyllum spicatum* (Eurasian Watermilfoil) is on its way to dominating the aquatic plant community of Parker Lake unless it is soon checked. It already comprises over 58% frequency of the aquatic plant community and is found at greater than average density. Its tenacity and ability to spread to large areas fairly quickly make it a danger to the diversity of Parker Lake's aquatic plant community. Targeting this plant by specific plant management techniques may help keep its spread in check. A plant management plan may also need to address the curly-leaf pondweed issue if this exotic becomes more abundant.

The Parker's Diversity Index for Parker Lake was .88, suggesting good species diversity. The Aquatic Macrophyte Community Index (AMCI) for Parker Lake is 56 (see Table 6) for Central Wisconsin Hardwood Lakes. The 4.05 Average Coefficient of Conservation score puts Parker Lake in the group of lakes most tolerant of disturbance in Wisconsin lakes and lakes in the North Central Hardwood Region. The aquatic plant community in Parker Lake is in the category of those most tolerant of disturbance, likely from a high amount of disturbance compared to other Wisconsin lakes.

The Floristic Quality Index of the aquatic plant community in Parker Lake of 18.55 is below average for Wisconsin Lakes and lakes in the North Central Hardwood Region. This indicates that the plant community in Parker Lake is among the group of lakes farthest from an undisturbed condition. This suggests that the aquatic plant community in Parker Lake has been significantly impacted by disturbance.

Traditional cultivated lawn and bare sand were the most frequent shoreline cover in Parker Lake and had a total coverage of over 35% together. Other disturbed sites, such as those with hard structure, rock/riprap and pavement, were also common, with coverage of over 23%. Of vegetated shorelines, herbaceous cover was most frequently found (100%), with coverage of just over 23%. Some type of disturbed shoreline was found at 92% of the sites and covered 58.75% of the shoreline. These conditions offer little protection for water quality and have significant potential to negatively impact Parker Lake's water by increased runoff (including lawn fertilizers, pet waste, pesticides) and shore erosion. Some type of natural shoreline was found at 100% of the sites, but only protected 37.91% of the shoreline. Expanding the amount of vegetation at the shoreline, especially with wide buffers, would help prevent erosion and reduce runoff into the lake that contributes to algal growth, increased sedimentation, and reduced water quality.

V. CONCLUSIONS

Parker Lake is a oligotrophic to mesotrophic lake with good to very good water quality and high water clarity. The quality of the aquatic plant community in Parker Lake is about average for Wisconsin lakes and for lakes in the North Central Hardwood region, as measured by the AMCI. Structurally, it does contain emergent plants, rooted plants with floating leaves, and submergents. However, the community is characterized by plants that tolerate a high amount of disturbance. Filamentous algae is common.

When the aquatic plant survey was performed, 100% of the littoral zone was vegetated. The potential for plant growth at all depths of the lake is present, even though some of the lake sediments are sandy. This growth percent is over the

recommended vegetation percentage for best fishing (50%-85%). There is likely to be on-going nutrient input into the lake from the large groundwatershed (see Appendix J). Although the 1.5'-5' depth zone supported the greatest plant frequency and density, the second depth zone (0-1.5') was not far behind.

The most frequent and dominant plant in the lake was actually a macrophytic algae, *Chara* spp. *Myriophyllum spicatum*, *Najas guadelupensis*, and *Potamogeton illinoensis* were sub-dominant. Nearly 94% of the sample sites had rooted aquatic plants.

Three other species reached a frequency of 50% or greater: *Myriophyllum spicatum* (Eurasian watermilfoil), *Potamogeton illinoensis* (Illinois pondweed), and *Potamogeton pectinatus*. In Parker Lake, species found in a greater than average density were: *Ceratophyllum demersum*; *Chara* spp.; *Myriophyllum spicatum*; *Najas guadelupensis* (Southern naiad); *Nymphaea odorata* (white water lily); and *Potamogeton illinoensis*.

A healthy and diverse aquatic plant community plays a vital role within the lake ecosystem. Plants help improve water quality by trapping nutrients, debris and pollutants in the water body; by absorbing and/or breaking down some pollutants; by reducing shore erosion by decreasing wave action and stabilizing shorelines and lake bottoms; and by tying-up nutrients that would otherwise be available for algae blooms. Aquatic plants provide valuable habitat resources for fish and wildlife, often being the base level for the multi-level food chain in the lake ecosystem, and also produce oxygen needed by animals.

Further, a healthy and diverse aquatic plant community can better resist the invasion of species (native and non-native) that might otherwise “take over” and create a lower quality aquatic plant community. A well-established and diverse plant community of natives can help check the growth of more tolerant (and less desirable) plants that would otherwise crowd out some of the more sensitive species, thus reducing diversity.

Vegetated lake bottoms support larger and more diverse invertebrate populations that in turn support larger and more diverse fish and wildlife populations (Engel, 1985). Also, a mixed stand of aquatic macrophytes (plants) supports 3 to 8 times more invertebrates and fish than do monocultural stands (Engel, 1990). A diverse plant community creates more microhabitats for the preferences of more species.

MANAGEMENT RECOMMENDATIONS

- (1) Because the plant cover in the littoral zone of Parker Lake is over the ideal (25%-85%) coverage for balanced fishery, consideration should be given to reducing plant growth in at least some areas. A map of areas to have plants removed should be developed, then removal should occur by hand to be sure that entire plants are removed and to minimize the amount of disturbance to the settlement.
- (2) Natural shoreline restoration is needed. Disturbed shorelines cover too much of the current shoreline, especially with many buildings less than 50' from the ordinary high water mark.. A buffer area of native plants should be restored around the lake, especially on those sites that now have traditional lawns mowed to the water's edge or buildings very close to the water's edge.

- (3) No lawn chemicals, especially lawn chemicals with phosphorus, should be used on properties around the lake. If they must be used, they should be used no closer than 50' to the shore.
- (4) An aquatic plant management plan should be developed with a regular schedule. Such plans will be required by the Wisconsin DNR for aquatic plant permits and grants and will also assist in reducing the frequency and density of the plants in Parker Lake.
- (5) The schedule should include target harvesting for Eurasian Watermilfoil (EWM) and Curly-Leaf Pondweed.
- (6) The Parker Lake Association should apply for grants from the Wisconsin Department of Natural Resources to help defray the cost of aquatic plant management.
- (7) No broad-scale chemical treatments of aquatic plant growth are recommended due to the undesirable side-effects of such treatments, including increased nutrients from decaying plant material and decreased dissolved oxygen and opening up more areas to the invasion of EWM.
- (8) Fallen trees should be left at the shoreline.
- (9) Although Adams County Land & Water Conservation Department currently takes regular surface water samples, the program only goes through 2006. Parker Lake residents should continue to be involved in the Wisconsin Self-Help Monitoring Program to permit on-going monitoring of the lake trends for basically no cost.
- (10) Parker Lake residents should identify, cooperate with and participate in watershed programs that will reduce nutrient and sediment inputs.
- (11) Emergent vegetation and lily pad beds should be protected where it is currently present and re-established where it is not. These not only provide habitat, but also help stabilize the sandy shores.

- (12) The areas where there is undisturbed wooded shore should be maintained and left undisturbed.
- (13) The Parker Lake Association should develop and implement a lake management plan that takes into account all inputs from both the surface and ground watersheds and addresses the concerns of this lake community.

LITERATURE CITED

- Dennison, W., R. Orth, K. Moore, J. Stevenson, V. Carter, S. Kollar, P. Bergstrom and R. Batuik. 1993. Assessing water quality with submersed vegetation. *BioScience* 43(2):86-94.
- Duarte, Carlos M. and Jacob Kalff. 1986. Littoral slope as a predictor of the maximum biomass of submerged macrophyte communities. *Limnol.Oceanogr.* 31(5):1072-1080.
- Dunst, R.C. 1982. Sediment problems and lake restoration in Wisconsin. *Environmental International* 7:87-92.
- Engel, Sandy. 1985. Aquatic community interactions of submerged macrophytes. Wisconsin Department of Natural Resources, Technical Bulletin #156. Madison, WI.
- Gleason, H, and A. Cronquist. 1991. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada* (2nd Edition). New York Botanical Gardens, N.Y.
- Jessen, Robert, and Richard Lound. 1962. An evaluation of a survey technique for submerged aquatic plants. Minnesota Department of Conservation. Game Investigational Report No. 6.
- Nichols, Stanley. 1998. Floristic quality assessment of Wisconsin lake plant communities with example applications. *Journal of Lake and Reservoir Management* 15(2):133-141.
- Nichols, S., S. Weber and B. Shaw. 2000. A proposed aquatic plant community biotic index for Wisconsin lakes. *Environmental Management* 26(5):491-502.
- Shaw, B., C. Mechenich and L. Klessig. 1993. *Understanding Lake Data*. University of Wisconsin-Extension. Madison, WI.